# Water Quality Implementation Plan for

# Kings Creek

# Northampton County, Virginia

**(Shellfish Areas Listed Due to Bacterial Contamination)**



**Prepared by:**
**Virginia Department of Conservation and Recreation**
**in cooperation with the Stakeholders of**
**Kings Creek**

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**ACKNOWLEDGMENTS**

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This booklet is an abbreviated version of the technical report, which can be obtained by contacting the Virginia Department of Conservation and Recreation (DCR). Agency contact information can be found on the back of this booklet.

## EXECUTIVE SUMMARY

Kings Creek, located on the Bay side of the Eastern Shore in Northampton County, was identified along with a portion of Cherrystone Inlet as impaired on Virginia's 1998 303(d) Total Maximum Daily Load Priority List due to violations of the State's water quality standards for fecal coliform. The creek does not support Virginia's bacteria standards for the production of edible and marketable shellfish. The applicable fecal coliform bacteria standard specified that the 90th percentile fecal coliform value for a sampling station not exceed an MPN (most probable number) of 49 per 100 milliliters. For every impaired water body on the 303(d) List, the Clean Water Act and the U.S. Environmental Protection Agency (EPA) both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant (40 CFR Part 130). A TMDL study was completed for Kings Creek and Cherrystone Inlet by the Virginia Department of Environmental Quality (DEQ) in 2007 which established the reduction in loads needed to restore these waters.

Virginia law requires that a plan be developed to achieve fully supporting status for impaired waters. In fulfilling the state's requirement for the development of a TMDL Implementation Plan (IP), it was determined that the focus be placed on the Kings Creek watershed for the implementation planning process. The condemnation area in the portion of Cherrystone Inlet that was originally part of the TMDL had been removed as of June 2010.

### Review of TMDL Development

DEQ used a simplified Tidal Volumetric Model along with bacterial source tracking to aid in identifying sources (i.e., human, livestock, pet and wildlife) of fecal contamination in the development of this TMDL. The TMDL for Kings Creek, Cherrystone Inlet was based on the 30-sample 90$^{th}$ percentile concentration, which was determined to represent the critical condition and required greater reduction. The TMDL allocations require bacterial load reductions of 85% for Kings Creek and Cherrystone Inlet.

### Public Participation

Public meetings were held to inform the public regarding the end goals and status of the IP process as well as to provide a means for soliciting participation in the smaller, more-targeted meetings (*i.e.*, working groups). For this Implementation Plan, a single working group was assembled from stakeholders with common concerns regarding the TMDL process and was the primary arena for seeking public input. The working group concentrated on reassessment of bacteria sources and identifying corrective actions based on these revised sources. Throughout the public participation process, major emphasis was placed on discussing corrective actions for septic failures, wildlife contributions, education programs, technical assistance, and funding.

### Assessment of Implementation Action Needs

Field surveys in the watershed and analysis of aerial imagery were used along with the stakeholder workgroup process, the TMDL study, and a preliminary coliscan sampling

survey to conduct a bacteria source reassessment and evaluate alternative BMPs and strategies to reduce the bacteria loads reaching the creek. The various practices were discussed by the workgroups regarding the costs, effectiveness, and appropriateness for the specific circumstances in the watersheds. Overall, the implementation needs for the five-year Phase 1 implementation period were identified and are shown in Table ES.1.

Cost estimates of the agricultural, residential, and other BMPs in this plan were calculated by multiplying the unit cost by the number of BMP units in each watershed. The unit cost estimates for the agricultural BMPs were derived from the Department of Conservation and Recreation's Agricultural Cost-Share Database. Average costs for BMP installations in Virginia were used. The unit costs for residential practices were developed through discussions with the local health department, the TMDL IP workgroups and estimates from previous TMDL implementation plans. Estimates for education programs were based on target audience size and experiences in other TMDL implementation plans. Total Phase 1 (years 1-5) implementation cost for Kings Creek is estimated to be $1,755,200. An additional $100,000 Phase 2 (years 6-7) implementation cost could be considered in order to fully implement the TMDL load allocation reductions.

**Table ES.1 BMPs needed for Kings Creek TMDL Implementation**

| | | |
|---|---|---|
| | **Agricultural BMPs** | |
| # | **Units** | **Practice** |
| 3 | System | Small Acreage Grazing System (SL-6AT) |
| | **Residential BMPs** | |
| # | **Units** | **Practice** |
| 300 | System | Septic Tank Pump Out (RB-1) |
| 67 | System | Septic System Repair/Replacement (RB-3, RB-4) |
| 50 | System | Alternative Waste Treatment System (RB-5) |
| 40 | Acres Treated | Vegetated Buffers on Residential Land |
| 50 | System | Pet Waste Composter |
| | **Education Programs** | |
| # | **Units** | **Practice** |
| 1 | Program | Boater Education Program |
| 1 | Program | Residential Education Program |
| 1 | Program | Watermen Education Program |
| | **Other BMPs** | |
| # | **Units** | **Practice** |
| 5 | System | Public Pet Waste Collection Facility/Signage/Supplies |
| 20 | Acres Treated | Woodland Buffer Filter Area |

The primary benefit of this implementation plan is reduced bacterial contamination in Kings Creek. Specifically, fecal contamination may be reduced to meet water quality standards and allow for the harvest of shellfish from at least part of the creek. Kings Creek already meets the state water quality standards for safe swimming. However,

further reducing fecal contamination levels in this creek, particularly from human sources will improve public health by reducing the risk of infection from fecal sources through contact with surface waters.

Corrective actions identified for the creek were based on opportunities available from the assessment of contributing sources. The Phase I implementation activities focus on human and human-influenced sources and address the existing opportunities to make reductions. The implementation planning process estimated a large contribution to the bacteria pollution from household septic systems. The corrective actions assigned to these possible sources consisted of septic repair or replacement as well as alternative on-site systems based on site conditions. The remaining septic systems were identified for pump-out maintenance as an implementation action through pump-out notices required for the locality's compliance with the Chesapeake Bay Preservation Act.

Additional Phase I implementation actions focused on pet waste management based on an estimate of pet population in the watershed, educational programs for pet waste as well as boaters and residents. Implementation actions involving the livestock source were limited based on the limited contribution from this source and consisted of small acreage grazing systems for the only 3 facilities identified in the source assessment.

The remaining implementation actions identified for Phase I were designed to indirectly address runoff included the expansion of buffers along the shoreline. Based on the miles of shoreline and existing buffer, an opportunity for increasing vegetated and forested buffers on residential land was identified.

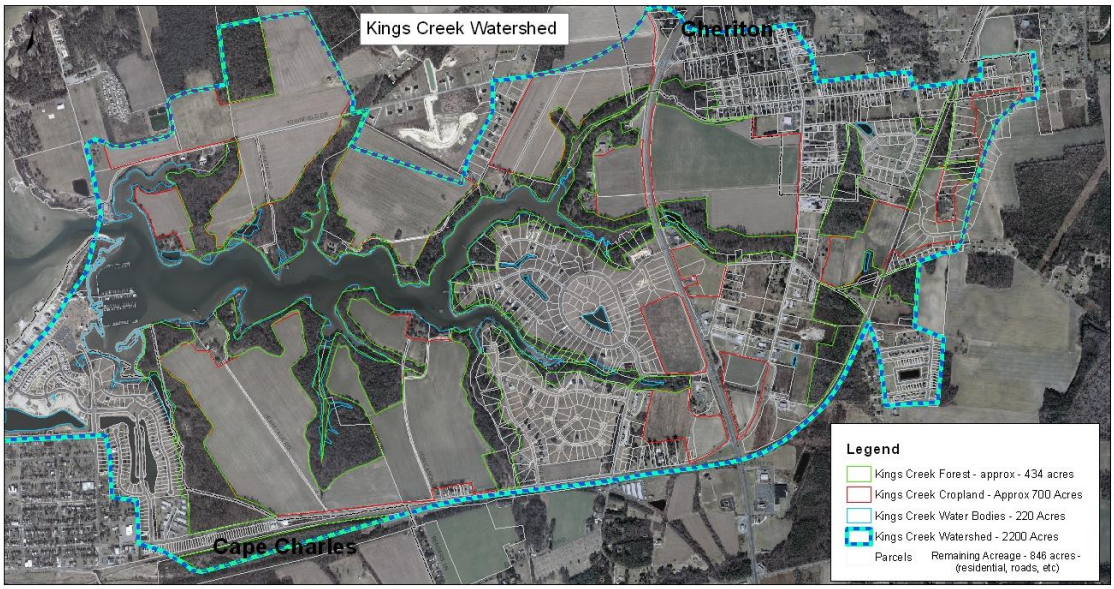
A significant source of bacteria in the watershed has been attributed, based on local knowledge and land use, to wildlife. It is difficult to address a natural population of wildlife and background bacteria levels. Phase II activities plan to address the wildlife contributions (indicated in the re-assessment of sources to be contributing 48% of the fecal coliform load) through a wildlife management plan to include housekeeping practices from shoreline land use to discourage wildlife as well as additional buffer proposed to indirectly treat runoff from these sources in the general watershed area.

## INTRODUCTION

### Background

Kings Creek is located in Northampton County on Virginia's Eastern Shore. The creek empties into Cherrystone Inlet with the original TMDL including a portion of Cherrystone Inlet. The watershed as identified by the IP working group (and redrawn from original TMDL to include additional area connected through a local drainage network) includes approximately 2,200 acres. Land use is broken down into broad categories in figure 1.

**Figure 1. Broad land use categories and acreages within the Kings Creek watershed**




The Creek is dominated by residential and agricultural land use with forest remnants adjacent to the creek. The creek is important for recreation and aquaculture, and the health of these waters is closely linked to the enjoyment of those who choose to live and visit this creek.

The Clean Water Act (CWA) that became law in 1972 requires that all U.S. streams, rivers, and lakes meet their state's water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards, including narrative or numeric, chemical, physical, or biological criteria. Through this required program, the state of Virginia has found that many streams do not meet state water quality standards for protection of the five beneficial uses: fishing, swimming, shellfish, aquatic life, and drinking water. Virginia submits a list on the health of all its waters to Congress every two years. No water body can be removed from the list until:

- Its problems are solved and standards are achieved or
- The designated uses not being achieved are removed after a detailed analysis clearly shows that they cannot be obtained.

When streams fail to meet standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL is a "pollution budget" for a water body. That is, it sets limits on the amount of pollution that a water body can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish controls to reduce pollution in order to meet water quality standards.

Once a TMDL is developed, measures must be taken to reduce pollution levels in the stream. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) states that the "Board [State Water Control Board, SWCB] shall develop and implement a plan to achieve fully supporting status for impaired waters". A TMDL Implementation Plan (IP) describes control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs) in the watershed, to be implemented in order to meet the water quality goals established by the TMDL. CWA regulations prohibit new discharges that "will cause or contribute to the violation of water quality standards."

**Applicable Water Quality Standards**

Water quality standards are designed to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.). Virginia Water Quality Standard 9 VAC 25-260-10 (Designation of uses.) states:

*A. All state waters, including wetlands, are designated for the following uses: recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.*

*E. At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under §§301(b) and 306 of the Clean Water Act and cost-effective and reasonable best management practices for nonpoint source control.*

*G. The [State Water Quality Control] board may remove a designated use which is not an existing use, or establish subcategories of a use, if the board can demonstrate that attaining the designated use is not feasible because:*

*1. Naturally occurring pollutant concentrations prevent the attainment of the use;*

6. *Controls more stringent than those required by §§301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.*

(For a complete listing of this legislative reference regarding the Designation of Uses in Virginia waters, please go to:
*http://leg1.state.va.us/cgi-bin/legp504.exe?000+reg+9VAC25-260-10*

For a shellfish supporting water body to be in compliance with Virginia's bacteria standards for the production of edible and marketable natural resource use, the Virginia Department of Environmental Quality (DEQ) specifies the following criteria (9VAC 25-260-160):

> *" In all open or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restriction classifications are established by the State Department of Health, the following criteria for fecal coliform shall apply; the geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) of 14 per 100 milliliters. The 90$^{th}$ percentile shall not exceed 49 MPN/100 ml."*

For those waters that do not meet the criteria, Chapter 310 of the Administrative Code describes the process by which shellfish grown in restricted (condemned) waters can enter the commercial market, a process referred to as depuration or relaying.

**Fecal Bacteria Impairments**

Fecal coliform bacteria are the most common cause for the impairments in Virginia shellfish growing waters. This group of bacteria is considered an indicator of the presence of fecal contamination, and a common member of the fecal coliform groups is *Escherichia coli.* Fecal coliform are associated with the fecal material derived from humans and warm-blooded animals, and their presence in aquatic environments is an indication that the water may have been contaminated by pathogens or disease-producing bacteria or viruses. Waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. Pathogens are concentrated in filter-feeding shellfish and can cause disease when eaten uncooked. Therefore, the presence of elevated numbers of fecal coliform bacteria is an indicator that a potential health risk exists for individuals consuming raw shellfish. Fecal contamination can occur from point source inputs of domestic sewage or from nonpoint sources of human (e.g., malfunctioning septic systems), wastes from livestock, pets and wildlife.

The shellfish impairments of Kings Creek is based on restrictions placed upon the harvesting of shellfish from these waters. The VDH condemnation area located within these waters is Growing Area #88. Those restrictions, issued by the DSS, are based on monthly monitoring data. DSS collects monthly fecal coliform bacteria samples from each of its sampling stations in Virginia's tidal estuaries. VDH-DSS calculates a geometric mean based on the most recent 30 months of sampling data.

This IP outlines a strategy for reducing anthropogenic loadings of bacteria to a level that complies with the TMDL. With completion of the IP, Virginia has identified a process of meeting the water quality goals for Kings Creek and a means to enhance local natural resources. Additionally, approval of the IP will enhance the opportunities for funding during implementation.

## STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

In developing this IP both state and federal requirements and recommendations were followed. Virginia's 1997 WQMIRA directs the State Water Control Board (SWCB) to "develop and implement a plan to achieve fully supporting status for impaired waters" (§62.1-44.19:4 through 19:8 of the Code of Virginia), in order to produce an IP that is approvable by the Commonwealth. WQMIRA establishes that the implementation plan shall include:

- the date of expected achievement of water quality objectives,
- measurable goals,
- corrective actions necessary and
- the associated costs, benefits and environmental impacts of addressing the impairments.

Section 303(d) of the CWA and current EPA regulations do not require the development of implementation strategies. The EPA does, however, outline the minimum elements of an approvable IP in its 1999 *Guidance for Water Quality-Based Decisions: The TMDL Process.* The listed elements include:

- a description of the implementation actions and management measures,
- a time line for implementing these measures,
- legal or regulatory controls,
- the time required to attain water quality standards, and
- a monitoring plan and milestones for attaining water quality standards.

It is strongly suggested that the EPA recommendations be addressed in the IP, in addition to the required components as described by WQMIRA. In the case of Kings Creek, where there are no permitted discharges according to DEQ, it is necessary to develop pollution reductions among the various land uses contributing to the problems in the creeks and revisions to land management practices in the watershed to ensure that water quality standards can be attained.

The EPA develops guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered during IP development to improve the likelihood of funding through this source. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;

3. Describe the nonpoint source (NPS) pollution management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation effort.

The process of incorporating these state and federal guidelines into an IP consisted of three major components:

1. Public participation
2. Implementation actions
3. Measurable goals and milestones.

Once developed, DEQ will present the IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDLs. DEQ will also request that the plan be included in the appropriate Water Quality Management Plan (WQMP), in accordance with the CWA's Section 303(e) and Virginia's Public Participation Guidelines for Water Quality Management Planning. As stated in the Memorandum of Understanding (MOU) between EPA and DEQ, DEQ will also submit a draft Continuous Planning Process to EPA where DEQ commits to regular updates of the WQMPs. So, the WQMP's will be the repository for all TMDLs and the TMDL IPs developed within a river basin.

## REVIEW OF TMDL DEVELOPMENT

Water quality monitoring data, bacteria source assessments and the allocated reductions in the TMDL study were reviewed to determine the implications of the TMDLs on IP development.

As part of the TMDL development, bacterial source tracking (BST) sampling was conducted by DEQ in Kings Creek. Bacterial source tracking is intended to aid in identifying sources (i.e., human, livestock, pet and wildlife) of fecal contamination in water bodies. The study used the antibiotic resistance approach (ARA) for the analysis which utilizes the premise that bacteria from different sources have different patterns of resistance to a variety of antibiotics. The shellfish water quality monitoring network consists of a total of 30 stations for Shellfish Growing Area 88. Of these 30 monitoring stations 5 are located in the impaired segment in Kings Creek. This TMDL study

examined bacterial monitoring data at these stations for a period of time from May of 2003 through December 2005. The BST results were used to estimate the percentage of the bacteria load coming from each of the source sectors; wildlife, human, livestock and pet. It should be noted that BST and ARA methods are still being developed and there are substantial limitations that should be considered when using the results. BST is not a quantitative tool and was only intended to be used to identify and estimate potential source loads to the study area.

A simplified Tidal Volumetric Model was used in the development of the TMDLs. The method used the volumes of the creeks being studied and the monitored fecal coliform concentrations to calculate the current load conditions. The creek volume and the State water quality standard were used to calculate the allowable load. The difference between the current load and the allowable load was then used to calculate the required reduction for the creek. Finally, the BST results were used to allocate loads to source sectors. The TMDL for Kings Creek is based on the 30-sample 90$^{th}$ percentile concentration, which was determined to represent the critical condition. The resulting loads and reductions from this analysis are shown in Table 1.

**Table 1. Load and Required Reduction for the Kings Creek TMDL**

| ***Condemnation Area*** | ***Volume ($m^3$)*** | ***Current Load (MPN/day)*** | ***Allowable Load (MPN/day)*** | Required Reduction (%) |
|---|---|---|---|---|
| 88-139 Kings Creek (VAT-C15E-10) | **58320** | **1.90E+11** | **2.86E+10** | **85%** |

**What does E+10 mean? See page 34 for an explanation of how large numbers are expressed in studies of bacteria.**

The fecal bacteria TMDLs for Kings Creek and Cherrystone Inlet were developed by DEQ. The TMDL study titled *Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacterial Contamination Cherrystone Inlet* approved in 2008 and is available on the internet via DEQ's website at http://www.deq.virginia.gov/tmdl/apptmdls/shellfish/cherryst.pdf. In development of this TMDL, the 90th percentile standard of 49 MPN/100 ml was used, since it represented the more stringent condition. The TMDL assigned maximum allowable loads for the identified sources in the watersheds.

The focus of this Implementation Plan is the Kings Creek watershed, since only a small portion of Cherrystone Inlet was included in the TMDL Study and the condemnation area in the Inlet was recently removed by VDH.

## PUBLIC PARTICIPATION

Collecting input from the public on restoration and outreach strategies to include in the IP was a critical step in this planning process. Since the plan will be implemented primarily by watershed stakeholders on a voluntary basis with some financial incentives, local input and support are the primary factors that will determine the success of this plan. The actions and commitments compiled in this document were developed through a public

participation process that included representation from citizens in the watershed, Northampton County government, Eastern Shore Soil & Water Conservation District, DCR, DEQ, VDH-DSS, and the Accomack-Northampton Planning District Commission. All citizens and interested parties in the watershed are encouraged to put the IP into action and contribute whatever possible to the restoration of this creek.

## Public Meetings for the Kings Creek Watershed

Public meetings were held to inform the public regarding the end goals and status of the IP project as well as to provide a means for soliciting participation in the smaller, more-targeted meetings (i.e., working groups). An initial informational meeting was held on December 9, 2009, to provide information on the focus of the effort, gauge public interest, and solicit working group membership. Due to the size of the Kings Creek watershed and the focus of the IP development effort, it was deemed adequate to form a single working group to address source reassessment and corrective actions for the watershed. Representatives of DCR/DEQ attended each working group meeting in order to facilitate the process and integrate information collected from the various attendees. At the end of the process, it was deemed necessary to hold a meeting of a Government Working group to review the roles and responsibilities of local, state, and federal government staff. The membership of this meeting also included members of the At-large Working Group. Details on these meetings are provided below.

The first public meeting was held in the former circuit courtroom at 16404 Courthouse Road in Eastville, VA in Northampton County on January 20, 2010. The meeting was publicized in The Virginia Register and on the Northampton County website as well as a wide distribution through email contacts. Information discussed at the meeting included a general description of the TMDL process, a more detailed description of TMDL and IP development, and a solicitation for participation in working groups.

The final public meeting for the Cherrystone Inlet, Kings Creek TMDL Implementation Plan was held on February 23, 2011 in the auditorium of the former Northampton Middle School, 7247 Young Street, Machipongo, VA. The meeting was publicized in The Virginia Register as well as a wide distribution through email contacts. The primary purpose of this meeting was to present the draft IP. A presentation was given describing the implementation plan using major components as an outline: review of TMDL development, public participation, assessment of needs, cost/benefit analysis, and implementation.

## Working Groups

As previously noted, a single working group was established due to the size of the watershed and narrow focus of the source reassessment and analysis. This At-large Working Group met 4 times during development of the Implementation Plan. Toward the end of the process, a Government Working Group meeting was also held to review roles and responsibilities and discuss an opportunity for additional bacteria source sampling.

The first meeting of the Working Group was held on April 14, 2010 and included 8 stakeholders representing local government, state agency staff, as well as watershed residents. The meeting agenda focused on the source re-assessment for the Kings Creek

watershed, including results from a Coliscan monitoring effort described below. In addition, the group discussed the wildlife numbers in the original TMDL and suggested revisions of these based on local knowledge.

A second meeting of the Working Group was held on May 26, 2010 and included 8 stakeholders again representing local government, state agency staff, as well as watershed residents. Results of the Coliscan study were discussed, including problems with sampling leading to an end of sampling. The group discussed in detail the sources in the watershed and revised numbers from the original TMDL based on updated information and local knowledge. There was also a critical discussion of the BST and a need to seek additional grant funds to pursue microbial source tracking as an alternative to BST data for source contributions.

A third meeting of the Working Group was held on July 1, 2010 and included a review of GIS data available for the IP development, a discussion of continuing a citizen monitoring program through grant funding, a review of the source assessment, identification of corrective actions for inclusion in the plan and a cost benefit analysis of those actions. The group did not decide to move forward with a citizen monitoring program, but continued discussion of the need to seek additional funding for microbial source tracking to better define bacteria sources in the watershed.

A fourth meeting of the Working Group was held on August 5, 2010 and was attended by 10 watershed stakeholders. The central focus of the group discussion was the current status of the effort and the consensus of the group on how to move forward. Due to offline discussion since the last meeting, there was some question as to whether the group wanted to proceed with the effort. A main concern of the group was the current initiative in the county to form a Public Service Authority and the possibility of connecting area residents to a centralized sewer system. Todd Herbert and James Davis-Martin reiterated that the PSA effort was not tied to the Implementation Plan effort in any way. In addition, some members of the group had questioned the validity of DEQ data from the 2007 TMDL Study and were concerned that flawed data was being used to justify the PSA. Todd Herbert informed the group that the data contained in the TMDL study was the responsibility of DEQ and that questions should be directed to that agency.

A fifth and final Working Group meeting was held on September 29, 2010 and was attended by 12 stakeholders representing local government, state agency staff, as well as watershed residents. Meeting participants were presented with a draft of corrective actions for review and provided feedback on those actions.

The Government Working Group (GWG) met on November 10, 2010, and was attended by representatives from local government and state agency staff as well as concerned watershed residents. The GWG addressed the resources and commitments of local, state and federal agencies that would contribute to the improved water quality of the creeks as well as grant funding sources for implementation. In addition, Working Group representatives discussed the new opportunity for additional bacteria source tracking through a grant from DEQ. The group agreed that this information would be helpful as the implementation effort moves forward.

The Steering Committee (SC) met on February 22, 2011 and was attended by 11 people with representation from the working group and including watershed residents and staff from local government, the local health department, the local conservation district, Eastern Shorekeeper, as well as state agency representatives for the review of the draft IP document. The SC also advised on the elements of the final public meeting and ensured that all recommendations of the working groups were incorporated into the plan. The SC made editorial and substantive suggestions for changes to the document at the meeting and through follow-up e-mails.

A great deal of time was committed to the plan development by local planning staff and state agency representatives and especially from concerned watershed residents who participated in every step of the process, including members Granville Hogg and David Boyd who dedicated a significant portion of their time to conducting additional water quality sampling and local watershed characterization. This IP is intended to be an example of a shellfish TMDL IP for the Eastern Shore of Virginia in the hopes that it may lead to other similar efforts in areas with the potential to grow shellfish and where citizens are highly motivated to initiate clean-up efforts of impaired growing areas.

## ASSESSMENT OF IMPLEMENTATION ACTION NEEDS

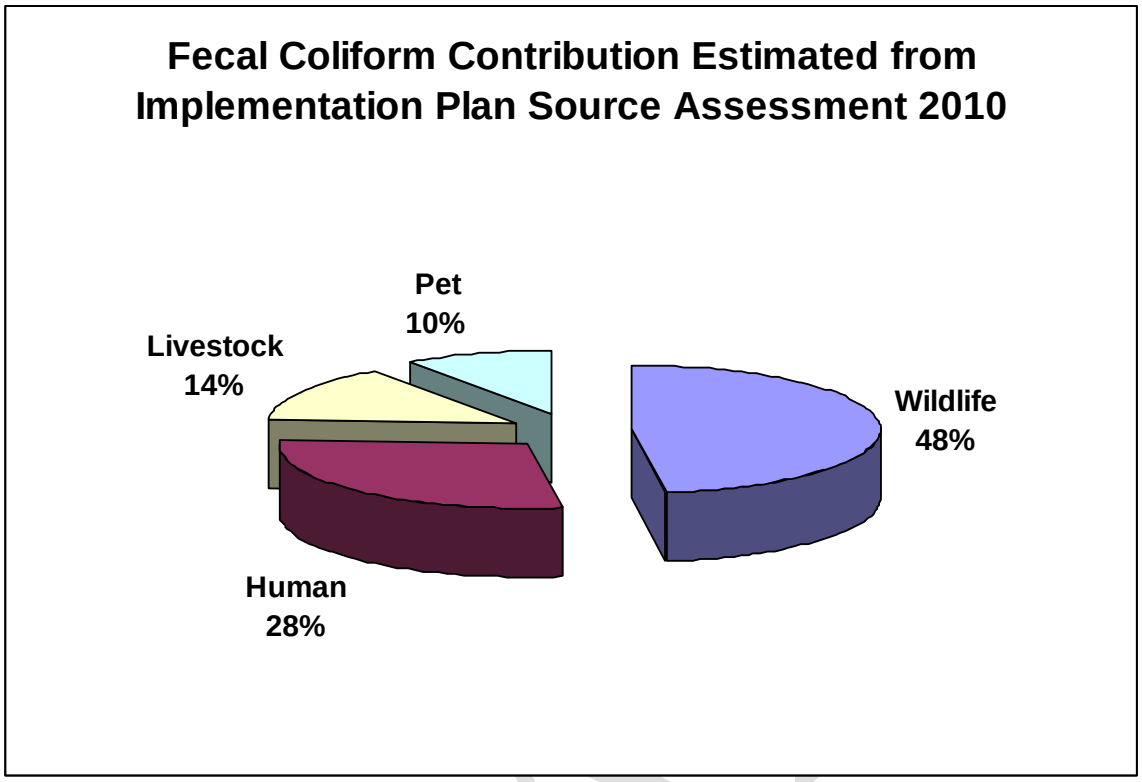
Due to the lack of analysis in the TMDL study as to the various delivery pathways (i.e., direct versus indirect) for the source load allocations that resulted from the BST analysis, and the potential changes in the watersheds from the TMDL study up to the IP process, a reassessment of the bacteria sources in the watersheds was conducted. The analysis was based on a reassessment of the number of residences in the watersheds, and quantification of human, pet, livestock and wildlife populations within the collective watershed. The daily fecal coliform contribution from each bacteria source was then quantified based on the population estimates, application rates and bacteria concentration values from the scientific literature. The results of this analysis are summarized in Table 2.

**Table 2. Results of Source Re-Assessment for Kings Creek from Revised Data**

| *Fecal Coliform Source Class* | *Fecal Coliform Source* | |
|---|---|---|
| Human | Sewer | 77 |
| | Septic | 300 |
| | Failing Septic (10%) | 104 |
| | No Treatment (3%) | 13 |
| | Biosolids | 0 |
| | Boat Slips | 50 |
| | Population | 1290 |
| | # of households | 494 |
| Livestock | Horse | 9 |
| | Cattle | 11 |
| | Pig | 0 |
| | Sheep | 60 |
| | Chicken | 70 |
| | Poultry Litter | 0 |
| Pet | Dog | 287 |
| Wildlife | Deer | 500 |
| | Duck | 283 |
| | Geese | 195 |
| | Raccoon | 112 |

The results of the analysis suggested that wildlife was by far the dominant bacteria producer in the watershed, followed by humans, pets, and livestock, although quantification of the source contributions based on BST analysis is problematic. Figure 2 illustrates the percent contribution attributed to each source class as a result of the new source assessment.

**Figure 2. Fecal Coliform Percent Contribution by Source**




**Selective Sampling for Hot Spots in the Watershed**[1]

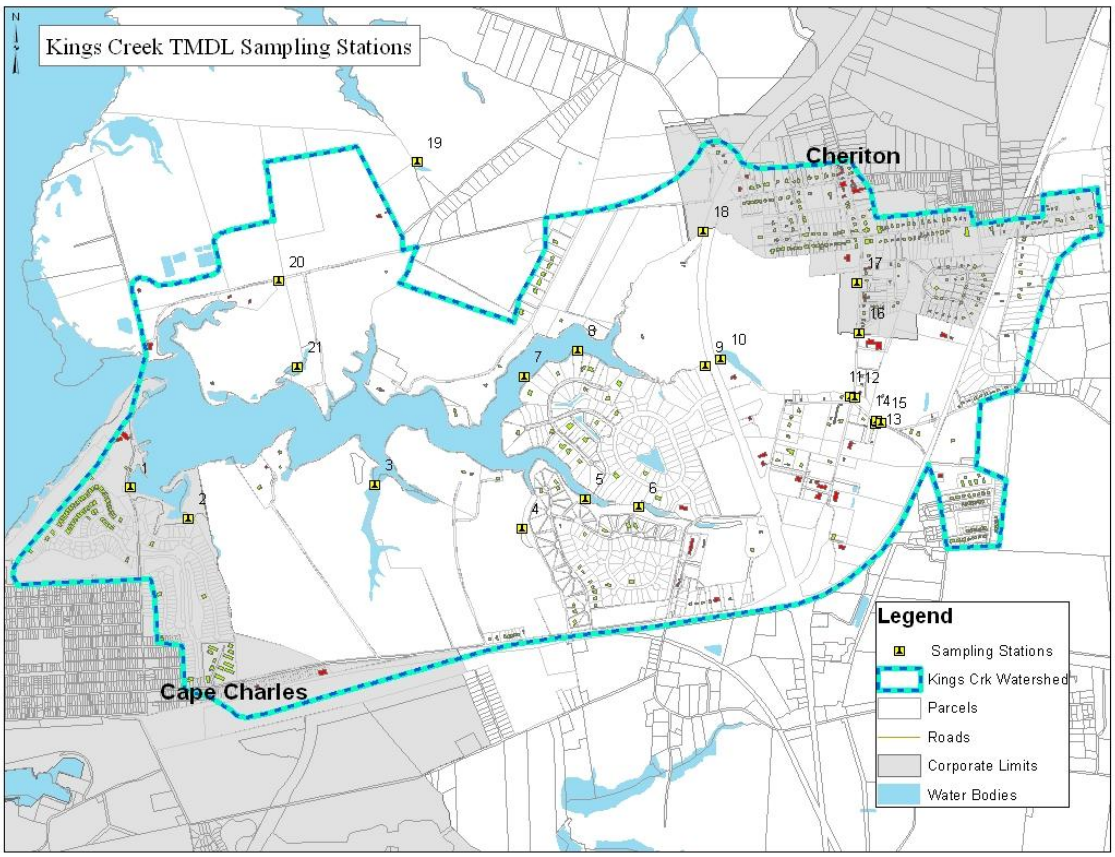
A citizen monitoring effort was undertaken in March 2010 to investigate hotspots in the watershed. The working group was provided with Coliscan kits by DEQ through the assistance of DCR staff. A small number of working group members graciously volunteered their time and worked diligently to collect data through a variety of weather conditions and antecedent precipitation events. The data collected are summarized in Table 3. A map of sampling locations identified by the working group is included in Figure 3. It is important to note that not all sampling locations identified were sampled for the preliminary study. Those depicted were suggested by the working group as locations for sampling and could be incorporated into a longer-term monitoring effort. For the preliminary study, the sample record is incomplete for some stations due to weather conditions. The preliminary results of the monitoring suggest that notable sources may be present in the more highly populated headwaters of the watershed, emphasizing the need to address human contribution from the more densely populated areas upstream in addition to the more sparsely populated cropland and residential areas downstream. More details on the coliscan data can be obtained by contacting DCR staff involved in the IP.

[1] Sampling locations were selected in part to explore the contributions from areas of the watershed not included in the watershed boundary from the TMDL study. Although a range of weather conditions were encountered, most collections followed significant rain events. For example, the significantly higher numbers for the March 29 samples may be attributed to a preceding rainfall event of greater than 2 inches. The purpose of the study was to get a sense of the bacteria pollution that may be coming from areas not previously included in the watershed boundary for the TMDL

**Table 3. Results of Coliscan Citizen Monitoring**

| Water Quality Sampling Results (# colonies per 100 mL) | | | | | | |
|---|---|---|---|---|---|---|
| Location | March 13 | March 20 | March 26 | March 29 | April 6 | May 3 |
| 18 | 220 | 380 | 480 | 480 | 0 | 140 |
| 9 | 80 | 20 | 540 | 3650 | 0 | 0 |
| 10 | 100 | 0 | 20 | 5520 | 0 | 0 |
| 11 | 240 | 100 | 860 | 9120 | 0 | 0 |
| 12 | 40 | 40 | 420 | 9600 | 0 | 720 |
| 14 | 180 | 0 | 220 | 4320 | 0 | 0 |
| 13 | 280 | | | 1760 | | |
| 8 | | 100 | | 1440 | | |
| 6 | 20 | 0 | 20 | 1540 | 0 | 0 |
| 5 | | 0 | 40 | 1000 | 60 | 0 |
| 21 | 80 | | 200 | | 0 | 60 |

**Figure 3. Sampling points identified for long-term monitoring.**



## The Need for Additional Bacteria Source Testing

The working group identified a crucial need, based on uncertainties from the BST analysis, to explore alternative source tracking opportunities. In particular, the group wanted to emphasize a need to distinguish between human and wildlife sources, something that might be obtained using molecular source tracking methodologies. A representative of a local sanitation district proved a valuable resource on these methodologies, unfortunately, a current study underway to compare these methodologies in watersheds from several neighboring Hampton Roads localities will not be completed before the submission of this plan. What is certain is that the cost of molecular methodologies is considerably higher than other methods and would require an independent funding search and subsequent study that is outside of the scope of the current implementation effort.

As of the current draft of this plan, a grant funding opportunity has become available to perform a small study using molecular source tracking techniques. An RFP is proposed and the work is scheduled to be completed by summer 2011. Results from this study will be applied to the implementation effort to help guide the direction of necessary corrective actions. As the implementation effort will be an ongoing effort of several years, such an addition to the library of information available for implementation will prove useful moving forward and may help to adjust priorities for implementation.

Field surveys in the watershed and analysis of aerial imagery were used along with the stakeholder workgroup process, the TMDL study and the bacteria source reassessment to evaluate best management practices (BMPs) and strategies to reduce the bacteria loads reaching the creek. The various practices were discussed by the workgroup regarding the costs, effectiveness, and appropriateness for the specific circumstances in the watershed. Table 4 identifies the list of practices considered for Phase 1 of this implementation plan, the cost per unit, the calculated reduction in fecal coliform derived from one unit of the practice (reduction efficiency) and the calculated reduction in fecal coliform derived per dollar cost of the practice (cost efficiency).

**Table 4. Efficiency of Phase 1 practices in reducing fecal coliform**

**Phase 1 Practice Efficiencies**

| Practice | Practice | Per Unit Cost | Reduction Efficiency | Cost Efficiency |
|---|---|---|---|---|
| Woodland Buffer Filter Area | FR-3 | 700 | 5.20E+07 | 7.43E+04 |
| Small Acreage Grazing System | SL-6AT | 3,400 | 4.47E+09 | 1.32E+06 |
| Septic Tank Pump Out | RB-1 | 220 | 5.00E+06 | 2.27E+04 |
| Septic System Repair | RB-3 | 5,000 | 4.13E+08 | 1.38E+05 |
| Alternative on Site Systems | RB-5 | 25,000 | 3.75E+09 | 1.50E+05 |
| Recreational Boater Education Programs | | 5,000 | 4.08E+07 | 8.17E+03 |
| Residential Education Programs | | 5,000 | 4.16E+09 | 8.32E+05 |
| Watermen Education Programs | | 5,000 | 3.21E+09 | 6.42E+05 |
| Vegetated Buffers on Residential Land | | 400 | 1.56E+07 | 8.17E+03 |
| Residential Pet Waste Composters | | 100 | 1.90E+08 | 3.90E+04 |
| Public Pet Waste Collection Facility/Signage/Supplies | | 700 | 1.50E+09 | 2.14E+06 |

The BMP and corrective action needs in the watersheds can be generally divided into four major categories; agricultural BMPs, residential BMPs, education programs and other BMPs.

**Agricultural BMPs**

Agricultural lands in the watersheds are predominantly row crops. The fields are generally well buffered, with buffer widths meeting or exceeding the requirements of the Chesapeake Bay Preservation Act (CBPA). There is currently no application of biosolids or manure in the Kings Creek watershed according to the local Soil and Water Conservation District. Vegetated buffers are the only BMPs identified to address bacteria sources from cropland in the watersheds.

The field surveys and stakeholder workgroups revealed only a few residents keeping livestock in the Kings Creek watershed. BMPs to address these small pastures include small acreage grazing systems to improve pasture and manure management practices and vegetated buffers. The small acreage grazing system BMP (SL-6AT) is a cost-shared practice in the Virginia Agricultural Cost-Share Program for TMDL Implementation areas.

**Table 5. Agricultural BMPs needed for Kings Creek**

| Agricultural BMPs | | |
|---|---|---|
| # | **Units** | **Practice** |
| 3 | System | Small Acreage Grazing System |

## Residential BMPs

Residential BMPs focus on the maintenance and repair of septic systems, identification and elimination of illegal "straight pipe" sewage discharges, the replacement of failed septic systems, installation of alternative waste treatment systems, and minimization of pet waste runoff from homeowner's yards through education, installing pet waste composters, vegetated buffers, as well as the installation of pet waste collection facilities in public access areas with high usage. It is also recommended that as part of the residential education, pet waste composters be provided to residents for managing pet waste on residential property.

In regards to septic pump-outs, the county mails septic pump-out notices to all property owners in the county. County officials were contacted to verify this process and a request was made to prioritize notices to property owners in the Kings Creek watershed given current efforts. As the county identifies non-compliant residences in the watersheds, they should be targeted for the appropriate implementation actions related to septic systems specified in Table 6. It should be noted that towns within the county are not included in these pump-out requirements, therefore a continued dialog with Cheriton town officials will be important to ensure these corrective actions can be implemented.

### Septic Failure Rate

Local estimates for septic failure rates vary and in the initial stages of planning a 10% failure rate was applied. It was originally assumed that this represented 10% failure over 5 years. However, in the fact sheet titled "Preventing Septic System Failure" (http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=25) failure rate of 1-5% (and higher in some areas) on an annual basis. Because of the limitations on the types of corrective actions available in this watershed based on current land use, a higher rate of 5% annually was applied to the source assessment. This corresponds to a repair or replacement of 5% of existing septic systems annually for a total of 25% of the systems being replaced in the watershed. Perhaps the proposed molecular source tracking study will suggest a lower contribution from septic systems moving forward in implementation. At current however, this replacement rate seems reasonable given the soil types and elevation in this watershed.

In addition to this estimated 25% failure rate for septic systems, a 3% occurrence was estimated for straight pipes, where household waste is directed with no treatment to a receiving stream. This plan proposes septic repair/replacement for failed systems and septic system installation where straight pipes are identified.

The plan also recognizes a need for alternative on-site septic systems where site conditions do not permit a traditional septic system. DCR staff met with county and local health department staff for an analysis that would help determine the number of alternative systems to prescribe for implementation. A GIS analysis was performed where

a soils inventory was layered over a land use map of the watershed as illustrated in Figure 3. It was estimated that approximately 200 homes within the watershed are located in areas with soils that would not meet current standards for traditional septic systems. The failure rate of 25% was then applied to these areas to arrive at a recommendation of the need for 50 alternative septic systems in the watershed as a component of the total failed systems needing replacement. This may be a conservative estimate given the soil types and elevation in these areas in the face of current health regulations.

**Figure 4. A map of the Kings Creek watershed with an overlay of soils determined by local health department staff to be unsuitable under current regulations for traditional septic system replacement.**

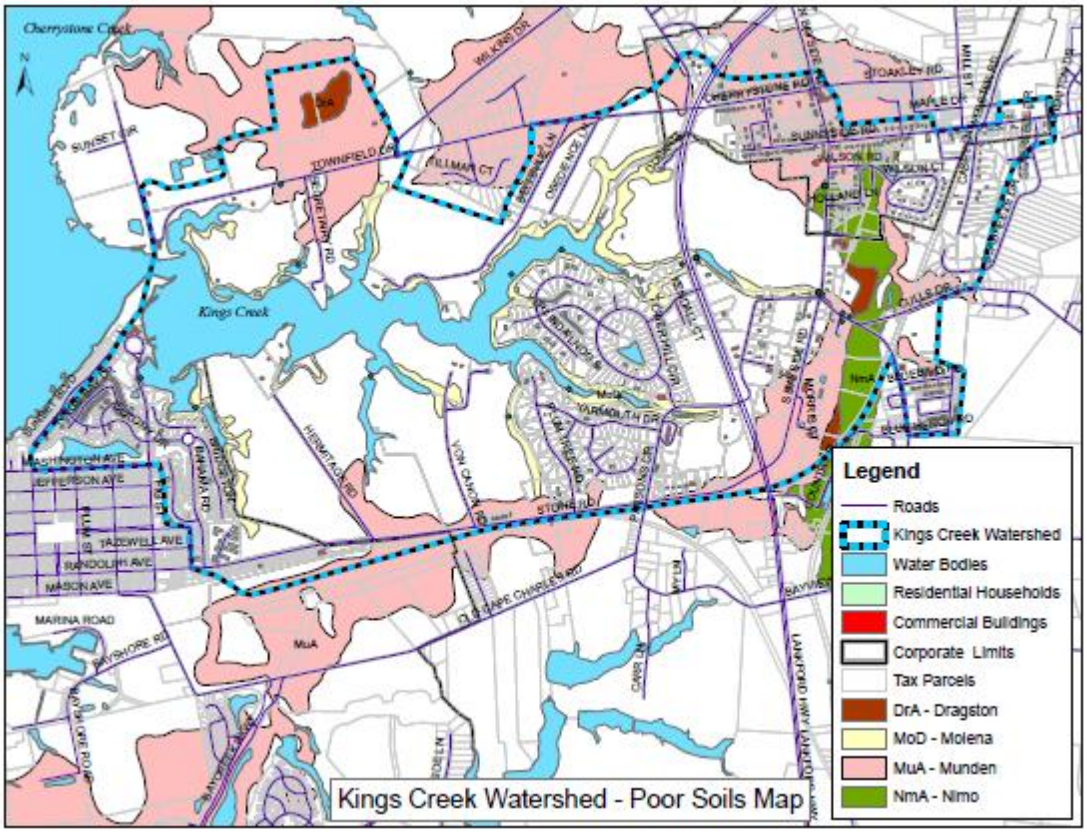



**Table 6. Residential BMPs needed for Kings Creek**

| Residential BMPs | | |
|---|---|---|
| **#** | **Units** | **Practice** |
| 300 | System | Septic Tank Pump Out |
| 67 | System | Septic System Repair |
| 50 | System | Alternative Waste Treatment System |
| 40 | Acres | Vegetated Buffer on Residential Land |
| 50 | System | Pet Waste Composters |

**Public Sewer for the Kings Creek Watershed**

It is important to note that there is an effort underway through a new public service authority to connect residents to a centralized sewer system. While this alternative would be effective at reducing bacteria levels attributed to human sources from failing septic systems, the costs for this alternative are substantial and require a high percentage of participation from residents. Due to the tentative nature of this alternative as well as apparent public opposition (as seen to a lesser extent with regards to a proposed no wake zone), this alternative has not been included in the suite of implementation actions for this plan. Should this alternative become a reality and implementation of this alternative occurs in the watershed, other needs for implementation can be adjusted to meet the goal of the plan.

Vegetated buffers area also proposed as a means of reducing bacteria from residential sources. It was estimated that there are approximately 850 acres in the watershed in residential or commercial land use. Phase I actions call for a 5% increase in vegetated buffers in these areas. In addition, based on the approximately 434 acres of forest, an approximate 5% increase of 20 acres is proposed for woodland buffer filter area. Although there is a significant portion of the watershed in cropland (approximately 700 acres), it was confirmed that there is no manure or biosolids application occurring in the watershed and therefore any likely reductions from generalized sources does not appear to support the $14,000 per unit cost of this practice.

## Education Programs

In addition to standard BMPs, several target audiences were identified for educational outreach efforts. The first group is recreational boaters that use the public boat ramp and marinas in Kings Creek along with other boaters that may enter the creek for recreational purposes and/or from private residential access. The focus of this educational effort will be to inform boaters about the availability of sanitary pump out facilities in the area and the detrimental impact overboard discharge of human waste can have on water quality. This educational effort may be in cooperation with DEQ's efforts to have Virginia's tidal creeks designated as No-Discharge Zones.

> **No Discharge Zones in Virginia**
> Recognizing the need to minimize the potential for contamination from any and all sources in these sensitive areas, the Virginia General Assembly unanimously passed House Bill 1774 in February, 2009. The Bill resolves that Virginia pursue NDZ designation for all its tidal creeks.
> -DEQ, (http://www.deq.virginia.gov/tmdl/ndz.html)

This designation would further restrict vessels from discharging wastes even after the wastes have been treated by approved marine sanitation devices.

A second education program will address watermen working and residing in the creeks. This program will focus its message on proper bait and fish waste disposal and general

shoreline "housekeeping" practices that can help control the wildlife concentrations in and near the creeks. This approach is especially important for the Kings Creek watershed, where the apparent contribution from wildlife sources is a large percentage of the total.

Finally, there will be several educational outreach efforts to residential property owners in the watersheds. The educational materials will address managing nuisance wildlife, pet waste management and proper care and maintenance of septic systems. Proper septic system maintenance includes: knowing the location of the system components and protecting them (*e.g.,* not driving or parking on top of septic tanks or drain fields, not planting trees where roots could damage the system), keeping hazardous chemicals out of the system, pumping out the septic tank every five years and knowing how to identify system problems. The working group also suggested cooperation with the local health department to recommend that education materials pertaining to septic systems care and maintenance be provided with permits for septic systems. The working group also suggested a measure that involved both a BMP and Education program whereby existing septic systems in the watershed be retrofitted with an inspection port over the distribution box to aid in visual inspection of the system. As an alternative to this, local health department staff recommended educating the public on the effectiveness of effluent filters in the tank itself, as a means to prevent clogging of the drain field should the tank reach capacity.

**Table 7. Education programs needed for Kings Creek**

| Education Programs | | |
|---|---|---|
| # | **Units** | **Practice** |
| 1 | Program | Boater Education Program |
| 1 | Program | Residential Education Program |
| 1 | Program | Watermen Education Program |

**Other BMPs**

The workgroup members identified several areas where there might be a large concentration of animals due to public usage of the area. These included wayside areas along Route13 where a large volume of traffic to/from the Chesapeake Bay Bridge Tunnel travels through the watershed. It is proposed that pet waste collection facilities/signage could be placed in these high traffic areas to reduce bacteria from transient watershed visitors. To further reduce the bacteria contributions from pet waste in the Kings Creek watershed, the workgroups proposed installing public pet waste disposal stations at marinas and the public boat ramps to address the pet waste generated from dogs coming off of boats.

**Table 8. Other BMPs needed for Kings Creek**

| Other BMPs | | |
|---|---|---|
| # | **Units** | **Practice** |
| 5 | System | Public Pet Waste Collection Facility/Signage/Supplies |

## Additional Working Group Recommendations for Implementation

In addition to the calculated BMPs for implementation, the working group recommended that the implementation effort pursue the effectiveness of changes to requirements for stormwater controls for new and existing commercial and residential development in the watershed. The group recognized the possibility that extended detention and increased design capacity for stormwater controls would help to reduce bacteria from generalized sources in the watershed. As this would require changes at the state and local level to planning and permitting requirements, efficiencies and reductions for these proposed practice changes are not known at this time. As the Implementation Plan is intended to be a living document, implementation priorities identified for the effort can be modified as these other opportunities are explored.

Additional recommendations from the group included examining the problem of fecal contamination of household refuse (soiled diapers for example) as this refuse is deposited at facilities in the county with indirect connection to surface waters. This would represent a unique approach leading perhaps to new BMP actions and is worth pursuing.

Finally, during discussion regarding pet waste collection, it was suggested that perhaps facilities for animal waste (Geese for example) could be established at marina or community developments. Such facilities, if accomplished at moderate expense and effort, would most likely be welcomed by residents in areas where these waterfowl and other wildlife congregate.

**Phased Implementation**

Because of the high percentage of the contribution from wildlife sources, it is estimated that the water quality standard will not likely be fully achieved with the proposed Phase I measures. In this watershed, if upon completion of initial implementation (Phase 1) water quality standards are not being met, the local citizens may elect to move forward with Phase 2 implementation to address the fecal coliform contribution from wildlife. This can be addressed through increasing buffers, increasing stormwater controls, as well as limiting direct contribution through a wildlife management plan, which involves the evaluation of wildlife populations and the management of them at sustainable levels based on local citizen's objectives. A use attainability analysis (UAA) may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources. The outcome of the UAA may lead to the determination that the designated use(s) of the waters may need to be changed to reflect the attainable use(s).

## COST / BENEFIT ANALYSIS

Cost estimates of the agricultural, residential, and other BMPs in this plan were calculated by multiplying the unit cost by the number of BMP units in each watershed. The unit cost estimates for the agricultural BMPs were derived from DCR's Agricultural Cost-Share Database. Average costs for BMP installations were used. The unit costs for residential practices were developed through discussions with the local health department, the workgroups and estimates from previous TMDL IPs. Based on the advice of local health department staff, the septic repair/replacement costs were adjusted and grouped into a single category to reflect cost realities for these practices. Estimates for education programs are based on target audience size and experiences in other TMDL IPs. Estimated implementation costs for each BMP are listed in Table 7. Total Phase 1 implementation cost for Kings Creek is estimated to be $1,755,200. An additional $100,000 Phase 2 implementation cost could be considered as an alternative to a UAA in Kings Creek.

The primary benefit of this implementation is cleaner waters in Kings Creek. The goal is to implement the IP so that fecal contamination may be reduced and allow for the removal of the condemnation of the shellfish growing areas. There is no commercial oyster culture or harvest in the creeks, he oysters growing in these creeks are being grown by property owners. The principal benefit to the oyster growers in these creeks would be that once the water quality is restored, they would no longer need to transport their floats to clean water to depurate the oysters prior to consumption. It is important to note that there are substantial aquaculture activities in nearby Cherrystone Inlet. All of these creeks already meet the state water quality standards for safe swimming. However, further reducing fecal contamination levels in these creeks, particularly from human sources will improve public health by reducing the risk of infection from fecal sources through contact with surface waters.

The residential programs will play an important role in improving water quality, but there may also be additional return on the investment in terms of economic benefits to homeowners. An improved understanding of private on-site sewage systems (including knowledge of what steps can be taken to keep them functioning properly and the need for

regular maintenance) will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The replacement of failing on-site sewage disposal systems with new septic or alternative treatment systems will have a direct and substantial impact, improving property values, and improving the local economy.

An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians, and a healthy economic base enhances the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document are expected to provide economic benefits, as well as environmental benefits, to the property owners in these watersheds.

**Table 9. Estimated implementation costs – Kings Creek**

| Units | Practice | DSWC Practice Number | Per Unit Cost | Estimated Cost |
|---|---|---|---|---|
| | **Implementation Costs** | | | |
| 20 | Woodland Buffer Filter Area | FR-3 | $ 700 | $ 14,000 |
| 3 | Small Acreage Grazing System | SL-6AT | $ 3,400 | $ 10,200 |
| 300 | Septic Tank Pump Out | RB-1 | $ 300 | $ 90,000 |
| 67 | Septic System Repair/Replacement | RB-3,4 | $ 5,000 | $ 335,000 |
| 50 | Alternative On-Site Systems | RB-5 | $25,000 | $ 1,250,000 |
| 1 | Recreational Boater Education Programs | | $ 5,000 | $ 5,000 |
| 1 | Residential Education Programs | | $ 5,000 | $ 5,000 |
| 1 | Watermen Education Programs | | $ 5,000 | $ 5,000 |
| 40 | Vegetated Buffers on Residential Land | | $ 400 | $ 16,000 |
| 50 | Residential Pet Waste Composters | | $ 100 | $ 5,000 |
| 5 | Public Pet Waste Collection Facility/Signage/Supplies | | $ 600 | $ 3,000 |
| | **Phase 1 Total** | | | **$ 1,755,200** |
| | **Optional - Phase 2 Implementation Costs** | | | |
| 1 | Wildlife Management Program | | 100,000 | $ 100,000 |
| | **Optional - Phase 2 Total** | | | **$ 100,000** |
| | **Total** | | | **$ 1,855,200** |

## STAKEHOLDER ROLES AND RESPONSIBILITIES

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private citizens, and special interest groups. Achieving the goals of the Kings Creek TMDL IP effort (*i.e.*, improving water quality and removing these waters from the impaired waters list) is dependent on stakeholder participation. Both the local stakeholders who are charged with the implementation of control measures and the government stakeholders who are responsible for overseeing human health and environmental programs must first acknowledge there is a water quality problem, and then make the needed changes in operations, programs, and legislation to address the pollutants.

The **EPA** has the responsibility for overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are five state agencies responsible for regulating and providing educational outreach for activities that impact water quality with regard to this implementation plan. These agencies include: Department of Environmental Quality, Department of Conservation and Recreation, Department of Health, Department of Agriculture and Consumer Services (VDACS), and VA Cooperative Extension (VCE).

**DEQ** has responsibility for monitoring the waters to determine compliance with state standards, and for requiring permitted point source dischargers to maintain pollutant loads and concentrations within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. Additionally, DEQ is responsible for presenting this IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDLs.

**DCR** manages numerous programs for addressing nonpoint sources of pollution. Historically, most DCR programs have dealt with agricultural NPS pollution through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the TMDL-required 100% participation of stakeholders. To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentives under this program have been adjusted to account for 100% participation. It should be noted that DCR does not have regulatory authority over the majority of NPS issues addressed in this document. Their Division of Chesapeake Bay Local Assistance enforces compliance with the Chesapeake Bay Preservation Act, including septic pump out requirements and the protection of Resource Protection Areas (RPA's) and Resource Management Areas (RMA's).

**VDH** is responsible for maintaining safe drinking water measured by standards set by EPA. Their duties also include On-Site Sewage Disposal regulation. Like VDACS, VDH's program is complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation from a failed septic system that may take many weeks or longer to achieve compliance. VDH has the responsibility of enforcing actions to correct or

eliminate failed septic systems and straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq*.) Their Division of Shellfish and Sanitation (DSS) is responsible for protecting the health of the consumers of shellfish and by ensuring that growing waters are properly classified for harvesting. DSS monitors water quality in shellfish growing areas, provide shellfish closings and sanitary surveys to identify deficiencies along the shoreline. They also administer the Marina Program to address the proper operation of pump out facilities and boater education.

**VCE** is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education and Extension Service, an agency of the United States Department of Agriculture. VCE is a product of cooperation among local, state and federal governments in partnership with local citizens. VCE offers educational outreach and technical resources on topics such as crops, grains, livestock, dairy, natural resources and environmental management. VCE has several publications related to TMDLs and is promoting water quality education and outreach methods to citizens, businesses and developers regarding necessary pet waste reductions. For more information on publications and county extension offices, visit www.ext.vt.edu.

The **Eastern Shore Soil and Water Conservation District** works with many agricultural producers in the region to improve agricultural practices and minimize impacts to the area waterways. In addition to the farming community, they work with citizens on erosion and sediment related compliance concerns and encourage innovative techniques for dealing with stormwater.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments, in conjunction with the state, can develop ordinances involving pollution prevention measures. Northampton County continues to implement the Chesapeake Bay Preservation Act on a county-wide basis. The County continues to issue pump-out notices to county residents and as a result of this plan effort has committed to prioritizing notices to target residences within the Kings Creek watershed. The county can take a leading role in pet owner education, possibly through dog licensing or other regular mailings to landowners, but would need assistance from the Steering Committee and other area groups like the ESSWCD for the content of materials. The implementation plan working group discussed the possibility of including water quality educational information in tax bills so that citizens are aware of specific problems around them. The county will be a key partner with other stakeholders in seeking grant funds to repair/replace failing on-site sewage disposal systems and to fund the various educational programs proposed in the IP.

Successful implementation depends on stakeholders taking responsibility for their role in the process. While the primary role falls on the landowner, the local, state and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. While it is unreasonable to expect that the natural environment (*e.g.*, streams and rivers) can be made 100% free of risk to human health, it is possible and desirable to minimize pollution related to humans. Virginia's approach to correcting NPS pollution problems has been, and continues to be, primarily encouragement of participation through education and financial incentives.

## MEASURABLE GOALS AND MILESTONES FOR ATTAINING WATER QUALITY STANDARDS

### Timeline and Milestones

The goals of implementation are restored water quality in Kings Creek, the removal of the shellfish growing areas from Virginia's Section 303(d) impaired waters list, and the lifting of the shellfish condemnations on the creeks. Progress toward the end goals will be assessed during implementation through tracking of BMP installations and continued water quality monitoring. Phase 1 implementation on these creeks is estimated to take five years. The septic BMPs identified in the implementation plan, including repairs, replacements and pump outs, will be continuous over a five year maintenance cycle.

**Year 1** will include 20% of the septic repairs and upgrades as well as the proposed implementation of alternative septic systems where needed. Year 1 will also include one watermen education program focused on nuisance wildlife management. Pump-out notices for the Kings Creek watershed have received priority as a result of this effort and will continue. In addition, Year 1 of the implementation effort calls for a 1% increase in residential and woodland buffers.

**Year 2** will continue septic repairs/replacements. Year 2 of implementation will also include one residential education program focused on pet waste management, the distribution and installation of residential pet waste composters and the expansion of vegetated buffers. Septic tank pump outs will continue to be implemented by residents identified as reaching the five year point since their last documented septic service.

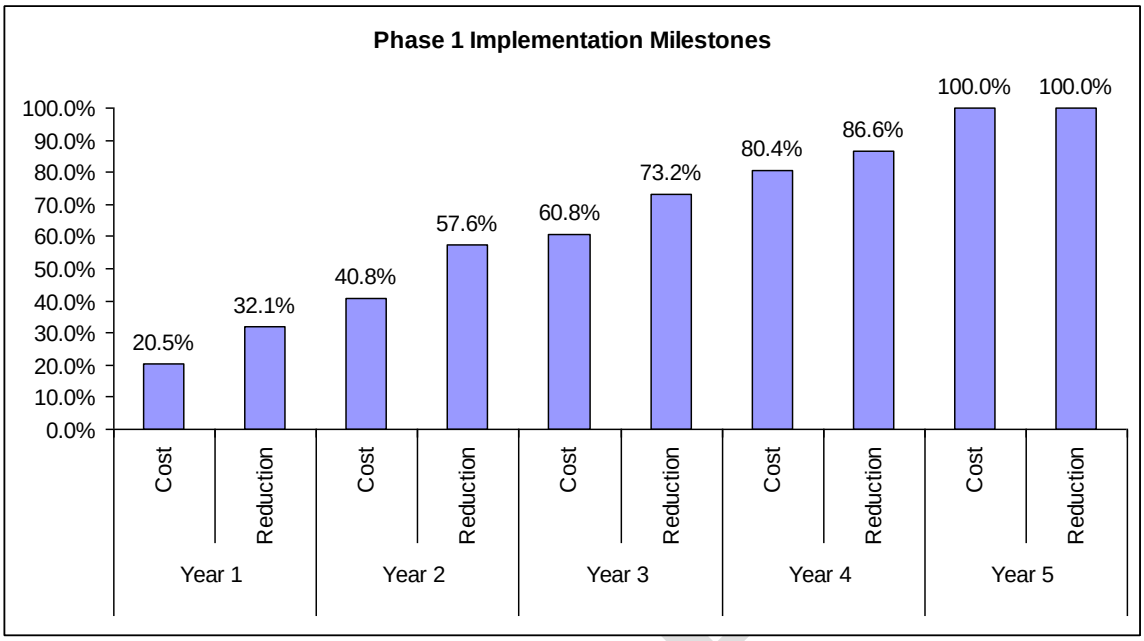
**Year 3** includes an education program for recreational boaters. Septic pump outs will continue to be implemented by residents identified as reaching the five year point since their last documented septic service. Septic repairs and replacement will continue. Year 3 will continue residential pet waste education thorough the installation of pet waste collection facilities and signage in selected areas of the watershed.

**Year 4** will continue septic repairs and alternative systems as well as increased establishment of residential and woodland treatment buffers. Septic tank pump outs will continue to be implemented by residents identified as reaching the five year point since their last documented septic service.

**Year 5** of the implementation plan provides an opportunity to complete any BMPs or education programs that were not able to be completed as scheduled. Septic tank pump outs will continue to be implemented by residents identified as reaching the 5 year point since their last documented septic service. Vegetated buffer establishment will continue.

Upon completion of the five year Phase 1 implementation period, all of the BMPs and education programs identified in this plan should have been implemented, thereby addressing all human sources of bacteria. The calculated fecal coliform reductions associated with the types and numbers of recommended practices estimate that bacteria loads will be reduced below the human and human-influenced source categories. However, the wildlife load for Kings Creek may still need to be addressed to meet TMDL reductions.

**Figure 5. Phase I Implementation Milestones**




Upon completion of Phase 1 implementation, water quality data will be reassessed to determine if the water quality standard is attained. If water quality standards are not being met, the local citizens may elect to move forward with Phase 2 (years 6 and 7) implementation to address the fecal coliform contribution from wildlife through a wildlife management plan, or a UAA may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources. The outcomes of the UAA may lead to the determination that the designated use(s) of the waters may need to be changed to reflect the attainable use(s).

## Tracking Implementation

Tracking of BMP implementation will serve as an interim measure of progress toward improving water quality in these creeks. Agricultural BMPs installed through the Virginia Agricultural Cost-Share Program will be tracked in the Agricultural Cost-Share Database. Repairs or replacements of on-site septic systems and straight pipes identified in the shoreline sanitary survey can be tracked through the VDH and can be monitored on their website at http://www.vdh.state.va.us/EnvironmentalHealth/Shellfish/documents/shoreline_survey.pdf. Northampton County may track pump out notices and associated compliance rates as part of their CBPA strategy.

## Monitoring

Improvements in water quality and implementation progress will ultimately be determined through monitoring conducted by VDH-DSS at the established bacteriological monitoring stations in accordance with its shellfish monitoring program. DEQ will continue to use data from these monitoring stations and related ambient

monitoring stations to evaluate improvements in the bacterial community and the effectiveness of TMDL implementation in attainment of the general water quality standard. VDH-DSS water quality monitoring data can be accessed using the agency's GIS Data Viewing tool which uses Google Earth© at:

http://www.vdh.state.va.us/EnvironmentalHealth/Shellfish/documents/ShellfishSanitation.kml.

**Figure 6. Kings Creek condemnation zone and monitoring sites**


**Table 10. VDH-DSS Water quality monitoring stations for Kings Creek**

| Station ID | Frequency | Type of Sampling |
|---|---|---|
| 88-15 | monthly | Fecal Coliform |
| 88-15a | monthly | Fecal Coliform |
| 88-15b | monthly | Fecal Coliform |
| 88-16 | monthly | Fecal Coliform |
| 88-17 | monthly | Fecal Coliform |
| 88-17.5 | monthly | Fecal Coliform |
| 88-18 | monthly | Fecal Coliform |
| 88-19 | monthly | Fecal Coliform |
| 88-20 | monthly | Fecal Coliform |
| 88-20 | monthly | Fecal Coliform |
| 88-21 | monthly | Fecal Coliform |
| 88-22 | monthly | Fecal Coliform |
| 88-23 | monthly | Fecal Coliform |

Preliminary Coliscan monitoring was performed by the group in Spring 2010. There is opportunity for the Steering Committee and associated partners to apply for funding

through DEQ for a Citizen Monitoring Program to track implementation progress and continue/refine targeting of sources in need of corrective actions.

## INTEGRATION WITH OTHER WATERSHED PLANS AND PROJECTS

Virginia's watersheds are managed under a variety of individual, though related, water quality programs and activities, many of which have specific geographical boundaries and goals. These include, but are not limited to, the Chesapeake Bay 2000 agreement, Tributary Nutrient Reduction Strategies, BAY TMDL 2010 Watershed Implementation Plan, TMDLs, Watershed Roundtables, Water Quality Management Plans, Watershed Management Plans, Erosion and Sediment Control regulations, Stormwater Management Program, Source Water Assessment Program, Green Infrastructure Plans, and local comprehensive plans.

Current on-going watershed projects or programs within Northampton County/Eastern Shore to be integrated with the Kings Creek TMDL IP include:

- Northampton County Comprehensive Plan
- Northampton County Septic Tank Pump-Out and Inspection
- Northampton County Chesapeake Bay Preservation Ordinance
- Accomack-Northampton Planning District Commission (A-NPDC) Septic System Pump-Out Assistance Program
- Department of Environmental Quality No-Discharge Zone
- Eastern Shore of Virginia Groundwater Committee
- Eastern Shore Soil and Water Conservation District Agricultural Cost Share Program

## POTENTIAL FUNDING SOURCES

Potential funding sources available for implementation were identified during development of this Implementation Plan. A brief description of the programs and their requirements is provided in this chapter. Detailed descriptions can be obtained from Eastern Shore Soil and Water Conservation District (NNSWCD), Virginia Department of Conservation and Recreation (DCR), Virginia Department of Environmental Quality (DEQ), Natural Resources Conservation Service (NRCS), Virginia Cooperative Extension (VCE) and others listed below. It is recommended that participants discuss funding options with experienced personnel at these agencies so as to choose the best option.

### Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient and sediment loads to surface waters. Eligible recipients include local governments, SWCDs, and non-

profit organizations. Grants for nonpoint sources are administered through VADCR. Most WQIF grants provide matching funds on a 50/50 cost-share basis.

**Virginia Agricultural Best Management Practices Cost-Share Program**

The cost-share program is funded with state funding administered through local SWCDs. Locally, the NNSWCD administer the program to encourage farmers to use BMPs on their land to better control sediment, nutrient loss, and transportation of pollutants into surface water and groundwater due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Cost-share is typically 75% of the actual cost, not to exceed the various cost-share caps, but there are also some that offer 50%.

**Virginia Agricultural Best Management Practices Tax Credit Program**

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, shall be allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. Any practice approved by the local SWCD Board shall be completed within the taxable year in which the credit is claimed. If the amount of the credit exceeds the taxpayer's liability for such a taxable year, the excess may be carried over for credit against income taxes in the next five taxable years. The credit shall be allowed only for expenditures made by the taxpayer from funds of his/her own sources. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs.

**Virginia Small Business Environmental Assistance Fund Loan Program**

The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to implement agricultural BMPs. The equipment must be needed by the small business to comply with the federal Clean Air Act, or it will allow the small business to implement voluntary pollution prevention measures. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. There is a $30 non-refundable application processing fee. The Fund will not be used to make loans to small businesses for the purchase and installation of equipment needed to comply with an enforcement action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

**Community Development Block Grant Program**

The Department of Housing and Urban Development sponsors this program, intended to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities primarily for persons of low and moderate income. Recipients may initiate activities directed toward neighborhood

revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

**Conservation Reserve Program (CRP)**

Offers are accepted and processed during fixed signup periods that are announced by the Farm Services Agency (FSA). All eligible (cropland) offers are ranked using a national ranking process. If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. Cost-share assistance is available to establish the conservation cover of tree or herbaceous vegetation. The per-acre rental rate may not exceed the Commodity Credit Corporation's maximum payment amount, but producers may elect to receive an amount less than the maximum payment rate, which can increase the ranking score. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. Land must have been owned or operated by the applicant for at least 12 months prior to the close of the signup period. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration.

**Wildlife Habitat Incentives Program (WHIP)**

WHIP is a voluntary program for landowners and land users who want to develop or improve wildlife habitat on private agriculture-related lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. In Virginia, these plans will be prepared to address one or more of the following high priority habitat needs: early grassland habitats that are home to game species such as quail and rabbit as well as other non-game species like meadowlark and sparrows; riparian zones along streams and rivers that provide benefits to aquatic life and terrestrial species; migration corridors which provide nesting and cover habitats for migrating songbirds, waterfowl and shorebird species; and decreasing natural habitat systems which are environmentally sensitive and have been impacted and reduced through human activities. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Applicants will be competitively ranked within the state and certain areas and practices will receive higher ranking based on their value to wildlife. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders and hedgerows. For cost-share assistance, USDA pays up to 75% of the cost of installing wildlife practices.

**Wetland Reserve Program (WRP)**

This program is a voluntary program to restore and protect wetlands on private property. The program benefits include providing fish and wildlife habitat, improving water

quality, reducing flooding, recharging groundwater, protecting and improving biological diversity, and furnishing recreational and esthetic benefits. Sign-up is on a continuous basis. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements of a minimum 10-year duration. Under the permanent easement option, landowners may receive the agricultural value of the land up to a maximum cap and 100% of the cost of restoring the land. For the 30-year option, a landowner will receive 75% of the easement value and 75% cost-share on the restoration. A ten-year agreement is also available that pays 75% of the restoration cost. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities. At any time, a landowner may request that additional activities be added as compatible uses. Land eligibility is dependent on length of ownership, whether the site has been degraded as a result of agriculture, and the land's ability to be restored. Restoration agreement participants must show proof of ownership. Easement participants must have owned the land for at least one year and be able to provide clear title.

**National Fish and Wildlife Foundation**

Offers are accepted throughout the year and processed during fixed signup periods. The signup periods are on a year-round, revolving basis, and there are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. An approved pre-proposal is a pre-requisite to the submittal of the full proposal. Grants generally range between $10,000 and $150,000. Projects are funded in the U.S. and any international areas that host migratory wildlife from the U.S. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, the proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated.

**Accomack-Northampton Planning District Commission**

Accomack-Northampton Planning District Commission provides full financial assistance to low-to-moderate income households in order for them to comply with septic pump-out requirements of the Chesapeake Bay Act.

## LIST OF ACRONYMS

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| IP | TMDL Implementation Plan |
| MOU | Memorandum of Understanding |
| MPN | Most Probable Number |
| ANPDC | Accomac-Northampton Planning District Commission |
| ESSWCD | Eastern Shore Soil & Water Conservation District |
| NPS | Nonpoint Source Pollution |
| RB-1 | Septic Tank Pump Out |
| RB-3 | Septic System Repair |
| RB-4 | Septic System Installation/Replacement |
| RB-4P | Septic System Installation/Replacement with Pump |
| RB-5 | Alternative Waste Treatment System |
| SC | Steering Committee |
| SL-6AT | Small Acreage Grazing System |
| SWCB | State Water Control Board |
| TMDL | Total Maximum Daily Load |
| UAA | Use Attainability Analysis |
| VDACS | Virginia Department of Agriculture and Consumer Services |
| VDH | Virginia Department of Health |
| WHIP | USDA Wildlife Habitat Incentives Program |
| WQ-11 | Vegetated Buffers on Cropland |
| WQMIRA | Virginia's 1997 Water Quality Monitoring, Information and Restoration Act |
| WQMP | Water Quality Management Plan |
| WRP | USDA Wetland Reserve Program |

**CONTACT INFORMATION**

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http://www.a-npdc.org/PDC.html

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http://www.esswcd.org/

Eastern Shore of Virginia Groundwater Committee
Accomack-Northampton Planning District Commission
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NRCS
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Northampton County Virginia Cooperative Extension
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http://www.deq.state.va.us/regions/tidewater.html

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# Expressing Large Numbers in Studies of Bacteria

Bacteria are very small. Expressing their numbers either in reduction per day or concentrations involves very large numbers. Since it is cumbersome to display large numbers in tables and text, scientists and engineers use a form of scientific notation to communicate these very large numbers in a more concise way.

For example, the value, 1,200,000,000 (one billion, two hundred million) can also be expressed as 1.2 times 100,000,000. As some will recall from grade school science, this multiplier can be expressed by applying an exponential notation. It looks like this:

$$1{,}200{,}000{,}000 = 1.2 \times 10^{9}$$

But another problem arises: how do you enter such a value into a computer? The times symbol isn't really the same as the letter "x", and most computers have no convenient way to indicate that a number should be written as a superscript. When the first computer languages were developed, and this problem was first considered, an alternative way of writing scientific notation was developed. In this alternative notation, the "times 10" is replaced by the letter "E" (probably for "exponent") and the exponent itself is written flush on the baseline instead of as a superscript. In this notation, the value 1,200 looks like this:

1.2 E 3 or 1.2 E+03

Some of the newer calculators are able to display scientific notation that looks like the first example above. However, older calculators, computer programming languages, spreadsheets like Excel, and web-based scripts all display and expect you to enter values in scientific notation using the format shown in the second example.

-Adapted from *http://chemlabs.uoregon.edu/GeneralResources/scientific_notation.html*